

Clustering at high redshift

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1 Near IR imaging of the HDF-S with VLT/ISAAC

The addition of deep near infrared images to the database provided by the HDF WFPC2 is essential to monitor the SEDs of the objects on a wide baseline and address a number of key issues including the total stellar content of baryonic mass, the effects of dust extinction, the dependence of morphology on the rest frame wavelength, the photometric redshifts, the detection and nature of extremely red objects (EROs). For these reasons deep near infrared images were obtained with the ISAAC instrument at the ESO VLT in the Js, H and Ks bands reaching, respectively, 23.5, 22.0, 22.0 limiting Vega-magnitude (5σ in an aperture of diameter $1''.2 \equiv 2 \times \text{FWHM}$, [3,4]).

2 A multi-color catalog of the HDF-S

A multi-color (F300, F450, F606, F814, Js, H, Ks) photometric catalog of the HDF-S has been produced [4] developing specific procedures to match HST and VLT data. Having in mind the generation of photometric redshifts we have chosen a conservative approach in the object detection, leading to a list of 1611 sources. After correcting for the incompleteness of the source counts, the object surface density at $I_{AB} \leq 27.5$ is estimated to be 220 arcmin^{-2} . The comparison between the median V-I colour in the HDF-North and South shows a significant difference around $I_{AB} \sim 26$, possibly due to the presence of large scale structure at $z \sim 1$ in the HDF-N.

Using for the object detection the Ks-band image we have selected down to $K_{AB} < 24$ a sample of 15 EROs, defined as sources with $(I - K)_{AB} > 2.7$, corresponding to the colour of passively evolving elliptical galaxies at $z > 1$. The EROs surface density turns out to be $3.2 \pm 0.9 \text{ arcmin}^{-2}$, and their distribution, at least from the angular point of view, is remarkably nonuniform: 10 EROs out of 15 are inside the upper WFPC2 chip (0.6 square arc-minute). One of the EROs is a powerful radio-galaxy.

3 Photometric and Spectroscopic Redshifts

Photometric redshifts have been produced both fitting templates to the observed SEDs [1,2] and with neural network techniques [5]. Using colour-colour diagrams, 90 U-band dropouts have been selected down to $I_{AB} = 27$ (19 are brighter than 25 mag). Spectroscopic observations of the 9 candidates with $I_{AB} < 24.5$ have been carried out, confirming all of them to be galaxies with $2 < z < 3.5$. Similarly, 17 B-band dropouts have been selected down to $I_{AB} = 27$ (all with $I_{AB} > 26$). A comparison of the 38 spectroscopic redshifts available so far with the photometric predictions, provides an estimate of the redshift accuracy σ_z of 0.16, 0.13 for the template fitting and neural network technique, respectively.

4 The Redshift Evolution of the Galaxy Clustering

The photometric redshifts for all the galaxies brighter than $I_{AB} < 27.5$ have been used to study the evolution of galaxy clustering in the interval $0 < z < 4.5$ [1]. The clustering signal is obtained in different redshift bins using two different approaches: a standard one, which uses the best redshift estimate of each object, and a second one, which takes into account the redshift probability function of each object and improves the information in the redshift intervals where the contamination from objects with insecure redshifts is important. With both methods, we find that the clustering strength up to $z \sim 3.5$ in the HDF-S is consistent with the previous results in the HDF-N. While at redshift lower than $z \sim 1$ the HDF galaxy population is un/anti-biased ($b < 1$) with respect to the underlying dark matter, at high redshift the bias increases up to $b \sim 2 - 3$, depending on the cosmological model. These results support previous claims that, at high redshift, galaxies are preferentially located in massive haloes, as predicted by the biased galaxy formation scenario. The impact of cosmic errors on the analysis has been quantified, showing that errors in the clustering measurements in the HDF surveys are indeed dominated by shot-noise in most regimes. Future observations with instruments like the ACS on HST will improve the S/N by at least a factor of two and more detailed analyses of the errors will be required. In fact, pure shot-noise will give a smaller contribution with respect to other sources of errors, such as finite volume effects or non-Poissonian discreteness effects.

References

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